Work Plan
Veta Grande Mine Site
Cyanide Destruction and Hydrogeologic Characterization Study

Prepared for:
U.S. Army Corps of Engineers
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Acronyms

BLM	Bureau of Land Management
CCJM	C.C. Johnson & Malhotra
CDM	CDM Federal
CFS	cubic feet per second
ft/ft	feet/foot
HSP	health and safety plan
MCL	maximum contaminant level
mg/l	milligrams per liter
NDCNR	Nevada Department of Conservation and Natural Resources
NDEP	Nevada Department of Environmental Protection
QA	quality assurance
QAPP	quality assurance project plan
RAMS	Restoration of Abandoned Mine Sites
RPD	relative percent difference
RSD	relative standard deviation
SOPs	standard operating procedures
TCLP	Toxicity Characteristic Leaching Procedure
USACE	United States Army Corps of Engineers
USBOR	United States Bureau of Reclamation
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VGCI	Veta Grande Companies Inc.
WAD	weak acid dissociable
WRDA	Water Resources Development Act

1.0 INTRODUCTION

1.1 OVERVIEW

This work plan has been developed by CDM Federal (CDM) in support of ongoing site characterization and cleanup activities at the Veta Grande Mine, Nevada, under U.S. Army Corps of Engineers ("the Corps") Contract DACW05-00-D-006, delivery order no. 007. This work plan has been developed under the authority of Public Law 106-53, Section 560 of the Water Resources Development Act (WRDA) of 1999. Under WRDA, Congress has provided direction to the Corps to establish the Restoration of Abandoned Mine Sites (RAMS) program. RAMS allows the Corps to provide assistance to other federal agencies and the states in addressing abandoned mine lands issues.

This work plan includes the following elements: Section 1.2 presents a description of the Veta Grande Mine site, sections 1.3 to 1.5 present environmental issues related to conditions at the mine site, Section 2.0 presents a summary of the scope of work being governed by this work plan; Section 3.0 presents the project organization, contacts, and schedule; and Section 4.0 presents the references reviewed in developing the site description. Appendix A provides the Field Sampling Plan; Appendix B the Quality Assurance Project Plan; while Appendix C includes the CDM standard operating procedures (SOPs) that govern field data collection and recording. Appendix D presents the health and safety plan (HSP) governing field work at the Veta Grande Mine site.

1.2 VETA GRANDE MINE SITE DESCRIPTION

1.2.1 Site Location

The Veta Grande Mine site ("the site") is located on public lands administered by the U.S. Department of Interior, Bureau of Land Management (BLM) Carson City District, Walker Resource Area. The site is located approximately 10 miles southeast of Gardnerville, Nevada and is approximately 0.25 miles east of U.S. Highway 395 (Figure 1) on the southwest flank of the Pine Nut Mountain range. The site is located within the northeast quarter of Section 9 and the northwest quarter of Section 10, Township 11 North, Range 21 East, Douglas County, Nevada and encompasses an area of approximately 90 acres (C.C. Johnson & Malhotra [CCJM], 1992; U.S. Geological Survey [USGS], 1979). The mine is immediately upgradient of 6 residences and Indian tribal allotment lands owned by the Washoe Paiute tribe.

Access to the site is provided via a dirt access road, approximately one mile in length, from U.S. 395. The access road does have a locked gate near the actual mine workings, but the site is not fenced except for the area around the cyanide pit.

The site is situated within a saddle area with three narrow, steep drainages. One drainage slopes to the southeast, one drainage slopes to the northwest, and a lesser drainage slopes to the west. Site climate is semi-arid with a normal annual total precipitation of approximately 12 inches (USDC, 1983; CCJM, 1994).

1.2.2 Site Geology

Rock types in the vicinity of the Veta Grande mine are early Mesozoic metavolcanic and metasedimentary rocks consisting of a variety of volcanic deposits with interbedded volcanic derived sedimentary materials (Moore, 1969). Mineralization occurred in a very thick quartz vein (over 50 feet [ft] thick in places) that cuts metavolcanic rocks interbedded with metasediments. The ore contains silver in streaks of the sulfide minerals argentite and stephanite, along with minor amounts of gold.

1.2.3 Site Mining History

The Veta Grande Mine was utilized as a silver and quartz mine/mill site from the 1800's until April 1983 (Pine Nut Chronicle, 1992) and both underground and surface mining occurred. In March 1981, the Veta Grande Companies Inc. (VGCI) submitted a Notice of Intent to conduct mining activities at the site to the BLM (Comstock Mining Services, 1981). The company filed for a Zero Discharge Permit from the Nevada Department of Environmental Protection (NDEP) on January 29, 1981 for operation of their crushing, flotation, and tailings deposition process. Permit NEV 20003 was issued on March 19, 1982 by NDEP (NDEP, 1982), and allowed for the operation of a small open pit silver mine utilizing drilling, blasting, loading, and hauling to a crusher plant, operation of a flotation mill, and disposal of mill tailings into constructed tailings ponds. The mine was permitted to mine and process up to 250 tons of ore per day. The permit specifically prohibited the use of cyanide. The VGCI issued a letter to NDEP on January 25, 1984 advising the NDEP that the Veta Grande mine and mill had been shut down as of April 1983 and that there had been no discharge from the mine or mill since that time. The BLM was notified in an April 12, 1985 correspondence (Cordero, 1985) that VGCI was no longer the owner and operator of the property and that title had been transferred to 20th Century Energy Corporation in March 1984. A February 10, 1986 BLM memorandum (Buder, 1986) indicated that 20th Century Energy Corporation had transferred the property to Wellington Financial Group, Nassau, Bahamas. It is reported that High Technology Recovery Systems leased the Veta Grande property in March 1983 with the intent to produce 10,000 ounces of silver per day (Pine Nut Chronicle, 1992); however, the lease was terminated abruptly in May 1983 with no commercial production. The claims have changed hands a number of times over the years, and ownership of the claims is uncertain at this time.

As discussed above, cyanide use was not permitted under the NDEP permit; however, in 1986, it was reported that the mine site had cyanide barrels and evidence of use of cyanide in the cyanide pit area (Buder, 1986; NDEP[Van Drielen], 1986). It is not known how much cyanide was used or how it was used in processing the ore.

Several illegal operations are alleged to have occurred at the mine site after mine and milling activities ceased, including an illicit drug manufacturing facility (CCJM, 1992) in the lab area and a "chop" shop for sale of stolen automobiles and automobile parts.

1.3 VETA GRANDE MINE SITE ISSUES

There are several issues of significant concern at the Veta Grande Mine site. These issues include:

- Concentrations of cyanide below its maximum contaminant level (MCL) of 0.2 milligrams per liter (mg/L) continue to be detected in residents water supply wells located immediately downgradient and within one-quarter mile of the mine site. It is believed that the cyanide pit is the source of the contamination and will continue to be a source of contamination until the area is remediated.

- Tailing impoundments 3, 4, and 5, located in the northwest sloping drainage, were not engineered or constructed in conformance with standard geotechnical stability practices. The tailing impoundments are located above residences and are estimated to contain approximately 27,200 cubic yards of tailings (CCJM, 1994). The long-term stability of these impoundments is questionable as there are no constructed spillways, the flowing mine adit discharges along the eastern edge of the impoundments, and this is a seismically active area. The sandy tailings deposited in these impoundments contain elevated levels of antimony, barium, lead, mercury, silver, zinc, and toluene. Although there has been significant volunteer revegetation, wind erosion and transport of exposed tailings is occurring. The Nevada Department of Dam Safety has classified these tailing impoundments as "high hazard dams" due to their poor construction and proximity to U.S. Highway 395 (Nevada Department of Conservation and Natural Resources [NDCNR], 1998).

- Arsenic has been detected in groundwater sampled from one water supply well, an on-site source well, and in Carter Springs and Danite Springs at concentrations exceeding its federal MCL of 0.05 mg/L. It is not clear at this time if the arsenic is a contaminant resulting from mining activities or if it is naturally occurring due to the highly mineralized nature of the area (BLM, 2001).

- Wind-borne transport of contaminated soils and tailings is also of concern.

These issues are considered critical because of the potential impact to human health and safety of the residents located immediately downgradient of the mine and to adjacent tribal lands of the Washoe Paiute Tribe. Other important site issues are:

- A thorough understanding of the site hydrogeology is necessary to determine the nature and extent of the groundwater contamination plume and downgradient impact.

- A flowing mine adit, located immediately upgradient of tailing impoundments 3, 4, and 5, is discharging water at a rate of approximately 4 cubic ft per second (cfs) along the eastern perimeter of the tailing impoundments and into the northwest drainage below the impoundments. The water quality from the adit is reported as good quality (BLM, 2001). The adit opening poses a risk to public safety, as it is unstabilized. Additionally, the diversion channel for the adit flow is in need of repair to prevent flow from entering tailing impoundments 3, 4, and 5.

- Engineered, permitted, and apparently properly constructed tailing impoundments 1 and 2 lie in the southeast drainage of the property. An estimated 14,600 cubic yards of tailings are deposited in these impoundments (CCJM, 1994). These impoundments were designed to remain stable during a moderate seismic event; however, neither impoundment has a spillway, allowing water to collect behind them. The sandy tailings have elevated levels of antimony, barium, cadmium, copper, cyanide, lead, mercury, selenium, silver, and zinc (CCJM, 1994). There has been significant volunteer revegetation on the tailings surface, but there are some areas that are exposed to wind erosion and transport.

- There is an open cut on the eastern hillside of the property that is not reclaimed; there is however volunteer revegetation in the cuts and benches. The site is not fenced or bermed and the public has access to the cut area.

- Other site features include a flotation mill foundation and equipment remnants, concrete sump, crusher site, boneyard, a below grade dump, several lab buildings, and assorted mining and milling debris scattered around the site that requires cleanup.

1.4 GROUNDWATER ISSUES

There are two groundwater wells located on-site. GW09 is located approximately 200 ft east of the mill foundation. The other unnamed well is located approximately 50 ft east of tailing impoundment 5. It is believed that water from these wells was used for mining and milling processes.

Residents within four miles of the site use groundwater for domestic drinking water. Six residential wells are located within one-half mile, downgradient, and northwest of the site. Four of these residential wells are approximately one-quarter mile from the mine's waste source areas. A seventh residential well is located approximately 1,500 ft west of the site.

Groundwater has been sampled semi-annually since 1992. The sample locations include four residential wells downgradient of the mill site, designated as GW01, GW02, GW03, and GW04. No depth to water or total well depth data is available for GW01 and GW04. GW02 is documented to be 90 ft deep and GW03 is 152 ft deep. Samples collected from 1993 to 2001 have been analyzed for weak acid dissociable (WAD) and total cyanide. Table 1 presents a summary of the historical sampling of these wells. None of the groundwater samples collected from the off-site wells contained cyanide in excess of its MCL of 0.2 mg/L. In addition to the four residential wells with low levels of cyanide, samples collected from GW06, located at Carter Springs, (in the northwest drainage approximately one-quarter mile from the site), have had cyanide detected in them. Arsenic exceeding its MCL of 0.05 mg/L has also been detected in samples collected from on-site well GW09 and in samples collected from GW06 at Carter Springs. Additionally, elevated arsenic concentrations have been detected in samples collected from residential well, GW13, and at Danite Springs, located approximately three-quarters of a mile to the southeast of the site. It is not known if the elevated arsenic levels are attributable to the mine, or are a result of the highly mineralized nature of the area (BLM, 2001).

The BLM has been providing bottled drinking water to four residences. A fifth residence has a water softener treatment system that may remove cyanide.

1.5 TAILINGS IMPOUNDMENT DESCRIPTION

Tailings impoundments 1 and 2 are located in a gulch on the southern side of the site in the southeast drainage. Dam 1 is the principal structure providing support to tailings impoundment number 1. It is registered with the Nevada Division of Water Resources as a high hazard dam, national ID number NVI0441 (U.S. Bureau of Reclamation [USBOR], 2000).

Table 1
Historic Groundwater Results for Cyanide

Sample Date	Zerby Resid. GW01		Chin Resid. GW02		Johnson Resid. GW03		Steck Resid. GW04	
	Total	**WAD**	**Total**	**WAD**	**Total**	**WAD**	**Total**	**WAD**
8/92	ND	NA	14	NA	65	NA	ND	NA
1/93	NS	NS	NS	NS	62	ND	NS	ND
6/93	9	7	19	ND	54	18	5	ND
10/93	ND	ND	ND	ND	ND	ND	ND	ND
11/93	ND	ND	48	7	77	11	20	ND
12/93	ND	ND	ND	ND	24	16	6	ND
1/94	NS	NS	NS	NS	NS	NS	NS	NS
2/94	ND	ND	9	ND	84	6	ND	ND
3/94	ND	ND	11	6	39	28	ND	ND
4/94	ND	ND	10	6	53	4	ND	ND
5/94	ND	ND	9	ND	33	8	ND	ND
6/94	ND	ND	18	12	17	7	ND	ND
7/94	ND	ND	ND	ND	18	8	ND	ND
8/94	ND	ND	11	6	38	17	ND	ND
9/94	ND	ND	8	5	65	12	ND	ND
1/95	ND	ND	8	ND	2	7	ND	ND
5/95	15	ND	9	ND	37	5	15	ND
8/95	ND	ND	6	ND	28	ND	ND	ND
11/95	NS	NS	NS	NS	NS	NS	NS	NS
12/95	ND	ND	ND	ND	24	ND	ND	ND
4/96	ND	ND	5	ND	40	9	ND	ND
7/96	ND	ND	6	ND	35	11	ND	ND

Dam 1 has a height of approximately 40 ft and supports deposited tailings, the surface of which is approximately 21 ft below the top of the dam embankment. Except for one small barren area, that requires some topsoil, most of the tailings surface is covered with vegetation thus preventing migration of the tailings by wind action. There is no spillway, and water ponds behind the dam during wet periods. The ponds are supporting wetland vegetation in the lower portion of the tailings surface. The dam embankment is vegetated with shrubs and grasses and there is no visible evidence of structural problems such as cracking, settlement, or slope failure associated with this dam. The lack of a spillway however is a significant problem. Given the excessive height of the dam above the tailings, a large body of water could impound behind this dam during an extreme storm event and possibly lead to dam failure by internal erosion (piping) of the embankment or by overtopping. Although there are no dwellings located below the dam, it does threaten U.S. Highway 395, and has therefore been classified by the State of Nevada as a high hazard dam (USBOR, 2000).

Dam 2 supports the tailings in impoundment 2 and is located above and in the same gulch as dam 1. The top of the embankment of dam 2 projects approximately 20 ft above the downstream tailings in impoundment 1 and 10 ft above the upstream tailings in impoundment 2. The total height of dam 2 is not known. The tailings in impoundment 1 (behind dam 1) cover and lend support to the toe of dam 2. There is a small area of barren tailings in impoundment 2; however, most of the tailings surface is vegetated. The foundation conditions of this dam are not known. Dam 2 also has no spillway. Field observation indicates that stormwater events do occasionally overtop this dam as evidenced by an erosion channel that has formed through the top of the dam embankment. Failure of the dam is not likely unless dam 1 failed and released the tailings from impoundment 1 (USBOR, 2000).

Tailings impoundments 3, 4, and 5 are located in a gulch on the northern side of the site at the head of the northwest drainage. These structures are located above several residences and were constructed without proper engineering or permission from the State of Nevada. Failure of these structures could result in release and migration of the tailings from the impoundments, property damage, and potential loss of life. It is estimated that 160,000 cubic yards of dam embankment material and tailings are contained in tailings impoundments 3, 4, and 5 (USBOR, 2000).

Impoundment 3 lies near the head of the gulch and is supported by two dam embankments. The uppermost embankment is a small structure located below the mill and served the purpose of preventing tailings from flowing out of the impoundment and back towards the mill. Dam 3 is located downstream of impoundment 3. Field investigations have shown that dam 3 is approximately 10 ft high and is founded on tailings that were deposited behind dam 4. The dam is vegetated with grasses and shrubs. There is no spillway. The tailings surface is approximately 3 ft below the top of the dam, is flat, and supports little vegetation. Wind action appears to be transporting tailings up the gulch towards the mill area.

Impoundment 4 is the most significant man-made earthen structure in the gulch. The impoundment has a height of 55 ft and supports the tailings located in impoundment 4. The embankment is assumed to be founded on colluvium; however, the conditions of its foundation have not been field verified. Prior exploratory excavations into the tailings and embankment have been performed to a depth of approximately 19 ft from the ground surface. Visual inspection of the tailings and embankment material indicated that they were not saturated to that depth. The tailings surface impounded by dam 4 is flat with sparse vegetation. Wind action appears to be transporting tailings up the gulch towards the mill. The dam embankment is vegetated with grasses and shrubs. No visible signs of structural distress have been observed. Tailings dam 4 does not have a spillway with the tailings surface being approximately 5 ft below the dam embankment. A stability analysis of dam 4, performed by the USBOR, indicates a need for improvements. Because the impoundment lacks a spillway and the flat surface of the tailings tends to pond water, the chances that the tailings and embankment will be partially saturated during a significant seismic event is probable and could result in dam failure.

Dam 5 supports the tailings in impoundment 5 that is only partially filled with tailings materials. The dam is 45 ft high and the tailings surface is approximately 7 ft below the top of the dam. The lower half of the tailings surface is partly covered with deciduous vegetation that is sustained by seepage and flow from the adit. The right side of the downstream toe also shows bright green vegetation and is indicative of subsurface seepage through the embankment and possibly from the adit diversion ditch. This vegetation is likely to have penetrated the dam embankment with tree roots and opened up seepage pathways through the structure. Dam 5 is also subject to partial saturation during a significant seismic event and dam failure could occur (USBOR, 2000).

1.6 PRIOR SITE INVESTIGATIONS

1.6.1 1991/1992 Site Investigation

In 1991 and 1992, the BLM directed a site inspection of the Veta Grande site to evaluate the human health and environmental threats due to mining wastes present at the site CCJM, 1994). The site inspection team sampled groundwater, adit drainage and spring, sediment, wastes, tailings, and soil. The samples were analyzed for standard CERCLA substances including metals, cyanide, volatile organic chemicals, and semivolatile chemicals. Cyanide was reported for all material tested. The metals antimony, arsenic, barium, cadmium, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc were reported above background for some of the samples.

1.6.2 1995 Federal Facilities PA/SI Review

Using the 1994 CCJM SI report as a basis, the BLM, State of Nevada, and USEPA Region IX conducted a Federal Facility Preliminary Assessment / Site Inspection Review of the Veta Grande site. The report prepared by the investigators (USEPA 1995) concluded that a release of hazardous substances has occurred through groundwater, surface water, and surface soil routes of exposure. The report also concluded that further assessment was warranted, but at a lower priority level.

1.6.3 2001 USEPA Investigation of Cyanide Waste

In December 2001, USEPA collected 39 samples of cyanide-contaminated mine waste at the site and analyzed the samples for metals and cyanide. Selected samples were also subject to TCLP waste characterization testing. Cyanide was reported for all of the samples. Some samples exhibited elevated concentrations of arsenic barium, chromium, lead, and mercury. Barium was the only element reported for the TCLP samples. Amenable cyanide was reported for a few of the samples.

Insert Figure 1

Insert Figure 2: Site Map

2.0 SCOPE OF WORK

The following text presents a summary of the work to be completed under this Work Plan.

2.1 TASK 1 - ADMINISTRATIVE ITEMS

2.1.1 Subtask 1.1 - Program Level Meetings. CDM will attend two program-level meetings to be held in either Reno or Carson City, Nevada. CDM will prepare the meeting minutes and submit them to the Corps, meeting minutes within three workdays of each meeting.

2.1.2 Subtask 1.2 - Attend Weekly Meetings. CDM will attend weekly meetings (as necessary and scheduled by the BLM) with the Veta Grande Team at the BLM offices in Carson City, Nevada. CDM will be responsible for recording meeting minutes, identification of action items, and preparation of the attendance list. Meeting minutes will be provided to the Corps and BLM attendees within 2 workdays of each meeting. It is expected that the meetings will average 1.5 hours per week. For costing purposes, it is assumed that 80 meetings will occur over the 2-year period of this assignment.

2.1.3 Subtask 1.3 - Weekly Project Status Reports. CDM will prepare and submit weekly project status reports to the Corps and BLM. The reports will summarize the activities that occurred during the prior 7-day period on a day-by-day basis. The reports will include results of any analytical or geotechnical testing obtained during the reporting period. In the event that no work occurred during the reporting period, CDM will provide a simple statement indicating such.

2.1.4 Subtask 1.4 – Weekly Field Reports. During the brief periods that CDM is in the field, CDM will provide to the Corps on a weekly basis, copies of field logs and field forms. The field records will include:

- Standby time
- Date and time work commenced and ended
- Weather and temperature
- Types of equipment used
- Names of personnel on site
- Names of visitors to the site
- Conditions encountered

2.1.5 Subtask 1.5 – Correspondence Log Maintenance. CDM will maintain a correspondence log of all telephone communications pertinent to the project, including but not limited to telephone calls, meetings, and summaries of discussions on both the project and program levels. The communication logs will be provided to the Corps within 3 workdays from the event.

2.2 TASK 2 – CYANIDE DESTRUCTION DEMONSTRATION PROJECT

2.2.1 Need for Cyanide Destruction Demonstration Project

In December 2001, USEPA's Emergency Response Office and their contractor removed for on-site containment, cyanide contaminated material once present in the cyanide pit at the mine site. To minimize the migration potential for the cyanide waste into the environment and particularly groundwater, the material has been wrapped in plastic and is presently stored at the site. This material needs to be either treated to detoxify the cyanide or removed from the site so that it no longer threatens human health or the environment. The primary focus of this task is to determine the most appropriate treatment and/or disposal means for the waste.

The BLM desires to dispose of this material offsite or detoxify and dispose of the material on site. Offsite hauling and disposal of the material at an approved facility may be the best method for eliminating potential future contamination from the cyanide pit material. However, disposal costs are likely to exceed the available budget for the cyanide demonstration project and on site treatment and disposal methods should be evaluated.

2.2.2 Scope of Cyanide Destruction Demonstration Project

The cyanide destruction demonstration project is divided into three subtasks:

1. Analytical evaluation of the cyanide contaminated material.

2. Presentation of cyanide contaminated soil treatment technologies, associated general cost estimates, and recommendation of preferred treatment or disposal option.

3. Implementation of bench scale testing or field work based on regulatory and public review and approval and available budget.

A description of each of the three subtasks is discussed below.

2.2.3 Existing Characterization Data

As part of the waste migration control effort, USEPA sampled the cyanide-contaminated material for total cyanide, metals, and extractable metals based on the Toxicity Characteristics Leaching Procedure (TCLP) method. Preliminary USEPA results show that the cyanide waste contains total cyanide between 1.9 and 210 mg/kg and amenable cyanide between non-detect at 0.5 mg/kg and 28 mg/kg. With the exception of barium, metals concentrations were not appreciably elevated and the waste would not be classified as hazardous based on the metals concentrations and TCLP results. A report of this sampling activity has not been made available to CDM.

CDM will use data collected by USEPA during the waste consolidation action to aid in evaluating treatment and/or disposal options for the material. To understand the origin of the data, CDM will seek additional information from USEPA regarding data origin including sampling method and sample locations. However, additional data will need to be collected to complete the waste characterization. Section 2.2.3 describes the purpose of the additional data collection.

2.2.4 Subtask 2.1 Analytical Evaluation

Initial review of the USEPA data provides information regarding total cyanide, amenable cyanide, metals content, and weak acid leaching potential of the material. Because the location of the existing samples are not known and there is a need for complete waste characterization data for a discrete sample, CDM will conduct the following analytical work on a discrete sample to assist in the identification of treatment options.

- Free cyanide, WAD cyanide, and total cyanide content of a representative waste sample.
- Alkalinity and soil pH.
- Meteoric Water Mobility Profile for a rinsate analysis of cyanide and heavy metal content.

The procedure for collection, recording, handling, and shipment of the soil sample is presented in the Field Sampling Plan (FSP), which is provided as Appendix A to this Work Plan. The Standard Operating Procedures (SOPs) that CDM will follow to collect and record samples are provided in Appendix C of this Work Plan. The analytical procedures for conducting these analyses are provided in Appendix B, the Quality Assurance Project Plan.

During the course of collection of field samples at the site, CDM will provide field health and safety training relative to the monitoring for cyanide gas, specifically hydrogen cyanide gas. During sampling, CDM will take appropriate precautions to assure the safety of all personnel at the site.

2.2.5 Subtask 2.2 Presentation of Cyanide Treatment Technologies and Recommended Bench Scale Testing or Field Program

The BLM has initiated work towards development of a waste treatment or waste disposal plan. This effort has included quantification of waste stored at the site, determining the area required for treatment, contacting vendors for treatment options and costs, and the evaluation of treatment options. CDM will obtain from BLM this information and use it where appropriate during the development of the treatment plan for the waste.

Based on the results of the chemical characterization of the waste material, a technical memorandum will be produced that identifies appropriate cyanide destruction technologies including chemical reagent treatment, physical fixing (cementation), soil rinsing and associated water treatment, and enhanced natural degradation. The technical memorandum will briefly describe the advantages and disadvantages of each on site treatment and disposal method and a general cost estimate range to implement each treatment method. In addition, a cost estimate will be provided for offsite haulage and disposal for the material. A recommended bench scale testing program or field implementation plan will also be identified. The letter report is intended to assist the agencies in the decision making process for remediation of the cyanide contaminated soil. Factors to be considered in the decision making process include effectiveness of treatment method, public comment (particularly from adjacent property owners and the Indian tribe), compliance with Nevada Department of Environmental Protection site closure requirements, interim versus final treatment and disposal, and available funding to implement treatment.

2.2.6 Subtask 2.3 Implementation of Bench Scale Testing or Field Work

Implementation of a recommended bench scale testing effort or actual field work to treat the waste is not included in the current scope of work. As discussed and agreed to with the USACE during contract negotiations, it is necessary to complete subtasks 2.1 and 2.2 and develop an approved and preferred treatment method prior to scoping and budgeting bench scale testing or field work. If it is determined that additional waste treatability data must be obtained prior to implementing field work, a complete bench scale testing program will be provided as the content of the deliverable described in subtask 2.2. If adequate data are available to implement field work without bench scale testing, then the subtask 2.2 deliverable will describe that effort. The Corps and BLM will need to identify the source of funds necessary for design and implementation of waste treatment and/or disposal.

2.3 TASK 3 – HYDROLOGIC CHARACTERIZATION STUDY

2.3.1 Need for Area Hydrology Investigation and Characterization

Cyanide released from the cyanide pit has contaminated underlying groundwater and it appears to have migrated off-site to impact the groundwater used by rural residents as their primary water source. Task 3 involves evaluating groundwater contaminant migration pathways and extent of the impacted groundwater in the vicinity of the local receptors. The BLM will use the results of this investigation to attempt to answer the following questions:

- Will the Washoe Tribal and allotment lands be affected by the contaminant plume, and if so, how?
- Has most of the contaminated portion of the plume already passed the domestic water wells?
- Are there economically viable subsurface treatment options available to control the cyanide plume?
- What alternative water supply sources or treatment options are recommended?
- What is the effectiveness of an existing residential water treatment system for the removal of cyanide?

2.3.2 Hydrologic Characterization Study Work Scope

The understanding of the area's hydrologic characteristics, sources, movement of contaminants, and definition of the contaminated groundwater plume will require completion of several subtasks. These include obtaining an understanding of the groundwater and bedrock conditions beneath the site, rate and direction of groundwater flow patterns, and groundwater quality data. To obtain the necessary information the required details regarding the site hydrology will be determined by completing the following subtasks:

2.3.3 Subtask 3.1 - Hydrogeologic Mapping

CDM will review available geologic and hydrologic reports to develop fracture maps and to gain an understanding of the characteristics of the bedrock and geologic setting. This subtask will include reviewing and studying of aerial photographs (stereoscopic evaluation, if photos are available) for surface indications (e.g., vegetation trends) that could assist in determining fracture trends in the bedrock.

2.3.4 Subtask 3.2 – Monitoring Well Installation

2.3.4.1 Monitoring Well Installation

CDM will install six wells in boreholes drilled to evaluate bedrock stratigraphy and fracture zones. The wells will be installed starting at the cyanide pit area and continuing to the area beyond the location of the off-site residences. This will allow completing a cross-section of the geology of the area, to a depth of 130 feet below ground surface. The six new wells will be drilled to 130 ft bgs, using sonic drilling methods in competent bedrock. The wells will be constructed of 2-inch diameter PVC.

The procedures for monitoring well installation are provided in Appendix A, the Field Sampling Plan. The procedures for logging the borehole and recording well details are provided in Appendix C, SOP 4-4. The procedures for well development and purging are provided in Appendix C, SOP 4-3.

2.3.4.2 Well Borehole Logging

To obtain data regarding bedrock conditions, CDM will log the core extracted from the borehole and will also perform geophysical logging in each borehole drilled for monitor well installation. The logging will include temperature and caliper logs to determine fracture intervals in the boreholes. The procedures for performing lithologic logging are provided in Appendix C, SOP 3-5.

2.3.5 Subtask 3.3 – Quarterly Monitoring Well Sampling

To complete the characterization of the hydrogeology for parameters related to understanding the fate and transport of cyanide, CDM will collect quarterly groundwater samples from 5 domestic wells and 6 new monitoring wells quarterly for eight quarters and 6 additional domestic wells annually. The first quarter will involve sampling of the 5 domestic wells for cyanide, only. After the installation of the six new wells, all 17 wells will be sampled for total, free, and WAD cyanide, and State of Nevada Profile II constituents. Total dissolved oxygen and electrical conductivity measurements will be taken from during purging of all wells during all sampling rounds. The results of sampling will be reported in quarterly data reports submitted subsequent to each sampling event. The procedures for groundwater sampling are presented in

Appendix C, SOP 1-5. The analytical procedures are presented in Appendix B, the Quality Assurance Project Plan. Table 2 presents a summary of the groundwater sampling effort.

Table 2
Groundwater Sampling Schedule
Veta Grande Mine Site

	J-02	S-02	D-02	M-03	J-03	S-03	D-03	M-04
GW01/Lamb	X	XX	X	X	X	XX	X	X
GW02/Glover	X	XX	X	X	X	XX	X	X
GW03/Johnson	X	XX	X	X	X	XX	X	X
GW12/Howard	X	XX	X	X	X	XX	X	X
GW14/Alexander	X	XX	X	X	X	XX	X	X
GW04/Jackson		XX				XX		
GW07/Redding		XX				XX		
GW11/Lamb		XX				XX		
GW13/Rodarte		XX				XX		
GW15/Zoppi		XX				XX		
Carter Springs		XX				XX		
NW 1		XX	X	X	X	XX	X	X
NW 2		XX	X	X	X	XX	X	X
NW 3		XX	X	X	X	XX	X	X
NW 4		XX	X	X	X	XX	X	X
NW 5		XX	X	X	X	XX	X	X
NW 6		XX	X	X	X	XX	X	X

X = Sample analyter: total, WAD, free cyanide
XX = Sample analyter: total, WAD, free cyanide; Nevada Title II
J = July; S = September; D = December; M = March

2.4 TASK 4 – TAILINGS IMPOUNDMENT 4

2.4.1 Need for Understanding Condition of Tailings Impoundment 4

The amount of mine/mill tailings placed within Tailings Impoundment 4 and the chemical characteristics of the tailing material are not known. It is suspected that the tailings have been placed in layers and that the material may vary in texture, structure, and chemical content by depth. Data regarding the depth of the tailing material are necessary to assess the volume of material contained behind the tailing dam. This information will be important to develop the containment and closure plan for the tailings impoundment.

2.4.2 Tailings Impoundment 4 Characterization

CDM will drill one borehole to determine the depth of the tailings behind impoundment dam 4. The estimated maximum depth of the tailings is 45 ft bgs, but they may be as shallow as 30 ft. CDM will collect discrete soil samples at 5-ft intervals, beginning at the surface, to the bottom of the boring (interface with native material). Depth of the last sample will depend on how far the sampling device can extend into native material. The discrete soil samples will be placed into sample containers and labeled as to sample interval. CDM will prepare a composite sample comprising material collected from each 5-ft interval. Each individual sample and the composite sample will be analyzed for total and WAD cyanide, and metals in accordance with analytical procedures presented in Appendix B, the Quality Assurance Project Plan. Table 3 summarizes the sampling effort completing the characterization of Tailings Impoundment 4.

Table 3
Summary of Soil Samples
Tailings Impoundment 4 Characterization

Number of Soil Samples	Analytical Suite
11[1]	Total Cyanide, WAD Cyanide, Metals

[1]Quality control duplicate samples will be analyzed at a frequency of 10% of total samples

Table 4 presents a summary of the samples to be collected under the guidance of this work plan. Appendix A, the Field Sampling Plan, contains additional details regarding the sampling procedures. Appendix B, the Quality Assurance Project Plan, provides details regarding the proposed analytical procedures.

Table 4
Summary of Proposed Overall Sampling Program

Sampling Program	Number of Primary Samples	Number of Quality Assurance Samples	Sample Analytes
Cyanide Waste Characterization	1	0	Free Cyanide Total Cyanide WAD Cyanide Alkalinity Soil pH Leachable metals, cyanide
Groundwater Sampling	94	10	Free Cyanide Total Cyanide WAD Cyanide
Groundwater Sampling	34	4	Nevada Title II constituents
Tailings Characterization	11	1	Totals, WAD Cyanide, Metals

2.5 TASK 5 – REPORTS

2.5.1 <u>Bench Testing/Field Testing Program Plan</u>

CDM will use the results of the characterization of the cyanide waste to develop a bench testing/field program plan that will be provided within a technical memorandum. This memorandum will describe the physical and analytical tests that will be performed on the waste material in an effort to identify the most-effective means for treating the waste and controlling waste migration. The memorandum will be included as an appendix of this Work Plan once reviewed and accepted by the Corps and BLM. In is anticipated that the QAPP developed for the collection of the waste samples will be need to be revised as appropriate to address sampling and analytical quality control related to the proposed testing program. This technical memorandum will also include the schedule for completion of the tests.

2.5.2 Site Hydrogeological Characterization/Tailings Impoundment 4 Report.

CDM will prepare a detailed outline of the report of hydrogeological investigations described in Task 3 and tailings impoundment 4 sampling described in Task 4 and submit it to the Corps for review and comment. The outline will be provided in Microsoft Word format.

Following acceptance of the report outline by the Corps, CDM will prepare the report presenting the results and findings of the site hydrogeological studies, including the review of aerial photographs, stratigraphy evaluation, soil borings, monitoring wells, and water quality results. Included will be site cross-sections and contaminant plume mapping. Also discussed will be recommendations for treatment of groundwater, including wellhead treatment at the residences, affected by cyanide originating at the Veta Grande Mine site.

The hydrogeologic characterization section will conclude with the results of CDM's evaluation of cyanide groundwater movement and threat to water supplies of residences and the Washoe Tribal and allotment lands. Recommended wellhead treatment options will be presented.

A section of the report will present the physical and chemical characterization of tailings impoundment 4. Recommendations for closure of the impoundment will be included.

Analytical data will be presented in tabular form. Supporting information will be included in appendices. The report will discuss additional steps / activities required to resolve long-term contamination issues at the Veta Grande Mine site. CDM will provide the report in draft form to the Corps for their review. The Corps will provide comments to CDM that may require revision of the document. Following incorporation of Corps comments, CDM will finalize the document.

2.5.3 Quarterly Groundwater Sampling Technical Memoranda

CDM will prepare quarterly groundwater sampling results technical memoranda corresponding with each event. The reports will include a description of the event and field measurements and analytical results presented in tabular format. The quarterly reports will include a brief narrative discussing trends and any significant observations noted during the sampling event.

3.0 PROJECT ORGANIZATION AND SCHEDULE

3.1 Project Organization and Contacts

This project is being managed by CDM under the direction of the Corps. Key project personnel and contacts are listed below.

Individual	Role	Organization
B.J. Bailey	Project Manger	Army Corps of Engineers
Neal Brecheisen	Project Manager	Bureau of Land Management
Kevin Ryan	Project Manager	CDM
Kerri Dierberger	Field Team Manager	CDM
John Wondolleck	Contract Manager	CDM

3.2 Schedule

The project schedule is presented on the following pages.

Proposed Schedule, page 1 of 2

Proposed Schedule, page 2 of 2

4.0 REFERENCES

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van Drielen, Harry (NDEP). 1986. *Field Report on Hazardous Materials at Veta Grande*. February.

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Contents

List of Tables

Attachments

1.0 INTRODUC TION

This Field Sampling Plan (FSP) presents the field sample and data collection procedures to be employed to address the objectives of the additional site characterization and pilot testing planning described in the Work Plan. The FSP includes references to Standard Operating Procedures (SOPs) that will be followed in order to assure that all samples collected will be representative of the physical and chemical characteristics of site media.

The field sampling activities addressed as part of this FSP include:

- Sampling of cyanide waste for development of a pilot testing plan
- Sampling of groundwater to complete hydrogeologic characterization of the site area
- Sampling of tailing materials to identify waste characteristics and tailings depth.

The intended use of the data collected under the guidance of this FSP is to provide the Bureau of Land Management (BLM) with information and recommendations to address treatment and containment of wastes found at the Veta Grande Mine site and potential treatment options for groundwater impacted by cyanide that originated at the Veta Grande Mine site.

2.0 OBJECTIVES OF FIELD SAMPLING

2.1 Cyanide Waste

Issues related to sampling of the cyanide waste, currently contained within a plastic "burrito", are described in Section 2.2 of the Work Plan. The objective of the additional sampling of the cyanide waste is to obtain the chemistry data necessary to establish the most appropriate treatment method for application in a cyanide detoxification and testing project. The results of the sampling effort will be presented in a Demonstration Project Testing Plan.

2.2 Hydrogeologic Characterization

The objectives of the hydrogeologic characterization program are provided in detail in Section 2.3 of the Work Plan. Groundwater beneath the mine site has become affected by cyanide. Migration of groundwater has impacted residential water wells for residences immediately downgradient of the site. Groundwater migration pathways are not completely understood. The extent of cyanide migration beyond the residences is not known. The hydrologic characterization is necessary to understand the fate and transport of cyanide in groundwater and to assist the BLM in identifying treatment and control measures for the affected groundwater.

2.3 Tailings Impoundment 4 Characterization

Tailings impoundment 4 may contain up to 45 feet of waste material stored behind an earth-works berm. The exact depth of the waste is not known and neither is its characteristics in terms of cyanide content, metals, content, pH, etc. The objective of this sampling effort is to collect data necessary to better understand the volume and regulatory status for ultimate identification of the most appropriate closure (cover) alternative.

3.0 FIELD SAMPLING PROCEDURES

3.1 INTRODUCTION

Presented in this section are summaries of the field sampling procedures to be employed by CDM while performing the work scope described in Section 2.0. All sample collection, recording, handling, and shipment will be in accordance with CDM SOPs included as Appendix C of this work plan.

3.2 CYANIDE WASTE SAMPLING

One (1) cyanide sample will be collected from the stockpiled soil material previously removed from the cyanide pit and stored wrapped in plastic at the site. The sample will be collected using a decontaminated stainless-steel trowel and placed into the proper pre-cleaned laboratory containers. The sample will be analyzed for free, total, and WAD cyanide, metals, alkalinity, and soil pH, and Meteoric Water Mobility Profile leach testing for cyanide and metals in accordance with the analytical methods presented in the Quality Assurance Project Plan (Appendix B). There will be no investigation-derived waste (IDW) produced as a result of this sampling activity.

The SOPs that govern the collection of this sample are presented in Appendix C and are listed below:

- SOP 1-2 Sample Custody (pages: all)
- SOP 1-3 Surface Soil Sampling (pages: 1-3; 11-12)
- SOP 2-1 Packaging and Shipping of Environmental Samples (pages: 1-4)
- SOP 4-1 Field Logbook Content and Control (pages: all)
- SOP 4-2 Photographic Documentation of Field Activities (pages: all)
- SOP 4-5 Field Equipment Decontamination at Non-radioactive Sites (pages: all)

The SOPs provide general procedures that will be followed for sample collection. The following text provides specifics regarding the sampling of cyanide wastes at the Veta Grande Mine site.

- Sampling equipment will be decontaminated and wrapped in plastic prior to entry of the Veta Grande Mine site
- Samples will be placed in sample containers pre-cleaned by the analytical laboratory
- Field information will be recorded in a field log book. Samples will be logged on a chain-of custody form. The samples will be kept secure on ice until prepared for shipment to the analytical laboratory.
- There will be no field duplicate or field equipment blank sample collected as part of this sampling effort.

Table A-1 summarizes the sample bottle type for each chemical analysis being performed on the waste sample.

Table A-1
Sample Analytes, Analytical Methods, Matrices, Containers and Preservatives

Analyte	Analytical Method[1]	Matrtix	Sample Container	Preservative
Total Cyanide	USEPA 335.2 USEPA 9045	Water Soil	1 liter poly 8-oz glass jar	NaOH to pH > 12 Ice to < 4ºC
Free Cyanide	USEPA 335.2 USEPA 9045	Water Soil	1 liter poly 8-oz glass jar	NaOH to pH > 12 Ice to < 4ºC
WAD Cyanide	USEPA 1677 USEPA 1677		1 liter poly 8-oz glass jar	Ice to < 4ºC Ice to < 4ºC
Total Metals	USEPA 200.8 USEPA 6010B	Water Soil	1 liter poly 8-oz glass jar	HNO_3 to pH <2 Ice to < 4ºC
Meteoric Water Mobility Profile	NDEP	Soil	8-oz glass jar	Ice to < 4ºC
Alkalinity	SM 2320B SM 2320B	Water Soil	1 liter poly 8-oz glass jar	Ice to < 4ºC Ice to < 4ºC
pH	USEPA 9040B	Water	1 liter poly	Ice to < 4ºC
Chloride	USEPA 300.0	Water	1 liter poly	Ice to < 4ºC
Fluoride	USEPA 300.0	Water	1 liter poly	Ice to < 4ºC
Nitrate/nitrite	USEPA 300.0	Water	1 liter poly	Ice to < 4ºC
Phosphorus	USEPA 365.1	Water	1 liter poly	Ice to < 4ºC
Sulfate	USEPA 300.0	Water	1 liter poly	Ice to < 4ºC
Total dissolved solids	SM 2540C	Water	1 liter poly	Ice to < 4ºC

[1]Or equivalent method achieving required detection limits. See Appendix B for analytical procedures.

3.3 GROUNDWATER SAMPLING

3.3.1 Domestic Well Sampling

Groundwater samples will be collected from domestic wells at residences adjacent to the mine site. Samples will be collected as close to the wellhead as possible, preferably prior to any surge or storage tanks. Each well will be purged and sampled in accordance with CDM SOP 1-9. Samples will be placed directly into the sample containers provided by the analytical laboratory. Table B-1 provides a summary of the bottle and preservation requirements for each of the chemical analyses to be performed on the groundwater samples.

Domestic well sampling will be performed during eight quarters in accordance with the field schedule (Table 2 of the Work Plan). The domestic wells and groundwater wells will be analyzed for free, total, and WAD cyanide during all quarters. For the annual sampling event, the samples will be analyzed for State of Nevada Profile II constituents (that include WAD cyanide), and free and total cyanide. The Quality Assurance Project Plan (Appendix B) presents the analytical methods to be used for each of the chemical tests proposed for the water samples.

The domestic well purge water will be assumed to be of drinking water quality and will not be contained, thus there will be no IDW produced during these sampling events. Attachments A and B provide the BLM rationale and sampling process for the domestic wells.

The SOPs that govern the collection of domestic well samples are presented in Appendix C and are listed below:

- SOP 1-2 Sample Custody (pages: all)
- SOP 1-9 Tap Water Sampling (pages: 1-6)
- SOP 2-1 Packaging and Shipping of Environmental Samples (pages: 1-4)
- SOP 4-1 Field Logbook Content and Control (pages: all)
- SOP 4-2 Photographic Documentation of Field Activities (pages: all)

The SOPs provide general procedures that will be followed for sample collection. The following text provides specifics regarding the sampling of domestic water at the Veta Grande Mine site.

- Samples will be collected directly into sample containers at the well head (or nearest location to the well head). Table A-1 presents the sample container and preservative requirements. There will not be a need for decontamination of sampling equipment
- Prior to sample collection, the domestic well will be operated for a sufficient amount a time to ensure that a representative groundwater sample is collected. The time for purging will be based on the location of the sample port to the wellhead, the depth of the well, and flow rate of the well discharge at the sampling port.
- Field information will be recorded in a field log book. Samples will be logged on a chain-of custody form. The samples will be kept secure on ice until prepared for shipment to the analytical laboratory.
- One field duplicate sample will be collected during each sampling event. There will not be a need for a field equipment rinsate sample because no equipment will be used as part of this sampling effort.

3.3.2 <u>Monitoring Well Sampling</u>

The 6 new monitoring wells to be installed as part of this investigation will be purged and sampled following their installation and development. The wells will be purged of at least three sample volumes, or until temperature, pH, and conductivity stabilize. Purging criteria are presented in Table A-2. The wells will then be sampled using a bailer. The water will be poured directly from the bailer into the appropriate pre-cleaned containers provided by the analytical laboratory. Purge water will be contained in 55-gallon drums pending receipt of the analytical results. The drums will labeled as to content and date of sampling and will be stored at a secured location at the site. The method of disposal will be determined by BLM. The wells will be sampled at the same times as the domestic wells, and the samples will be analyzed for the same analytes as are the domestic wells.

Table A-2
Well Purgewater Stability Criteria

Parameter	Criteria
Temperature	± 1 ºC
pH	± 0.5 pH units
Conductivity	± 1.0 µS/cm
Turbidity	± 1 5.1 NTU

The SOPs that govern the collection of monitoring well samples are presented in Appendix C and are listed below:

- SOP 1-2 Sample Custody (pages: all)
- SOP 1-5 Groundwater Sampling Using Bailers (pages: 1-5)
- SOP 1-6 Water Level Measurements (pages: 1-5; 8-9)
- SOP 2-1 Packaging and Shipping of Environmental Samples (pages: 1-4)
- SOP 4-1 Field Logbook Content and Control (pages: all)
- SOP 4-2 Photographic – Documentation of Field Activities (pages: all)

3.4 SOIL BORING SAMPLING

One soil boring will be drilled at the location of Tailings Impoundment 4 to determine the depth of the tailings behind the dam. The boring will be continuously cored using sonic drilling methods and the core material will be lithologically logged according to the Unified Soil Classification System (USGS) by a qualified geologist. The estimated maximum depth of the tailings is 45 ft. Soil samples will be collected from the cored material at 5-ft intervals, starting at the surface and ending within the interface with native material. A composite sample consisting of material collected from each 5-ft interval will be prepared for laboratory analysis by mixing soil from each interval in a stainless steel bowl using a stainless steel spoon. Each individual sample and the composite sample will be transferred into the appropriate sample containers and submitted to the laboratory for analysis for total and WAD cyanide and total metals. Table A-1 summarizes the sample container requirements. Appendix B presents the analytical methods.

The SOPs that govern the collection of subsurface soil samples are presented in Appendix C and are listed below:

- SOP 1-2 Sample Custody (pages: all)
- SOP 1-4 Subsurface Soil Sampling (pages: 1-4; 13-19)

- SOP 2-1 Packaging and Shipping of Environmental Samples (pages: 1-4)
- SOP 4-1 Field Logbook Content and Control (pages: all)
- SOP 4-2 Photographic – Documentation of Field Activities (pages: all)

3.5 MONITORING WELL INSTALLATION

The boreholes for the six monitoring wells will be drilled using the sonic drilling method. The use of this method allows for a cleaner borehole that reduces the amount of drill cuttings (i.e., IDW) and provides a continuous core for logging purposes. Each well boring will be logged as it is drilled, using the cores that are retrieved from the borehole, according to the USCS by a qualified geologist. Exhibit A-1 provides an example borehold log. Information will be recorded on this form based on visual checks of the core. Following logging of the core, the core will be stored at the site. Prior to well installation, the boreholes will also be geophysical logged by a professional provided by the driller.

The monitoring wells will be installed for the purpose of monitoring groundwater downgradient of the Veta Grande mine site. Well installation will be performed to be consistent with CDM SOP 4-4. The following is a summary of the procedures to be used during this investigation:

- All casing, screens, bottom caps, and centralizers will be decontaminated by the driller prior to installation in the borehole. Casing will be steam cleaned and allowed to air dry.
- Casing and screen will be 2-inch diameter, Schedule 40 PVC, with flush-threaded joints. The total depths of the wells may change depending on the actual conditions encountered in the field (i.e., based on depth to water). All blank casing and screen will be installed to assure plumbness and alignment of the wells. Each well will be completed inside of the drive casing.
- Screen length will be 25 ft. Screen slot size will be 0.010 inch (ten thousandths of an inch) PVC. The bottom of each well will be sealed with a threaded end cap.
- Stainless-steel centralizers will be installed at the top and bottom of each screen, and at 60 ft above the top of each screen in each well.
- The annulus around the well screens will be filled with a formation stabilizer consisting of inert, well-rounded, 8x20 Monterey silica sand, or equivalent. The formation stabilizer will be brought up 5 ft above the top of the screens.
- An annular seal will be placed above the sand pack, consisting of at least three ft of pure bentonite pellets hydrated according to manufacturer's instructions, followed by a Portland cement / powdered bentonite grout mixture. The grout will be tremied from the top of the bentonite seal upwards to approximately 3 ft bgs, within the annular space

INSERT EXHIBIT A-1

between the drive casing and the well casing. The cement/bentonite grout will be mixed in accordance with State of Nevada regulations.

- The surface completion will consist of a locking steel protective casing with a minimum of 2 ft stickup above ground surface. A 2-inch diameter slip cap will be placed over the top of each casing. Each well will be locked with a padlock to prevent unauthorized access. The lock will be keyed per BLM requirements.

Immediately following well installation, but no less than 48 hours, the completed well will be developed to remove fine-grained sediment from the filter pack and promote aquifer flow into the well. The following general procedures will be used:

- Each well will be developed using a combination of surge block, bailing, and submersible pump methods. Development water will be contained in 55-gallon drums to be stored at a secure location at the site. Pending receipt of well water quality results, the BLM will make the determination regarding disposal of the development water.

- Wells will be developed until a water sample tests less than 5 nephelometric turbidity units and is relatively free of suspended material, or until the well has been purged for a total of 4 hours. A minimum of three casing volumes of water will be removed. The bailer, surge block, and submersible pump will be decontaminated prior to use in each well.

- The development water will be monitored periodically for temperature, conductivity, and pH using a Hydac combination conductance, temperature, and pH tester, or similar instrument. Measurements will be recorded in the field logbook and on the well development log. The rate of water level recovery will be monitored immediately following well development using a freshly decontaminated water level probe, and the measurements recorded on the well development log.

- All well construction and well development information will be recorded in the field logbook and on the well development log. The monitoring well construction log form will be completed and referenced in the field logbook. Exhibit A-2 presents an example monitoring well construction-log form.

The SOPs that govern the logging of boreholes and installation of monitoring wells are presented in Appendix C and are tested below:

- SOP 2-2 Guide to Handling Investigation–Derived Waste (pages: all)

- SOP 3-4 Geophysical Logging, Calibration, and Quality Control (pages: 1-6; 19-25)

- SOP 3-5 Lithologic Logging (pages: 1-11)

- SOP 4-1 Field Logbook Content and Control (pages: all)

INSERT EXHIBIT A-2

- SOP 4-2 Photographic Documentation of Field Activities (pages: all)
- SOP 4-3 Well Development and Purging (pages: all)
- SOP 4-4 Design and Installation of Monitoring Wells in Aquifer
- SOP 4-5 Field Equipment Decontamination at Non-radioactive Sites (pages: all)

During well development, water stabilization will be monitored through the taking of temperature, pH, conductivity and turbidity measurements. Table A-3 summarizes the development criteria.

Table A-3
Well Development Measurement Criteria

Parameter	Criteria
Temperature	± 1 ºC
pH	± 0.5 pH units
Conductivity	± 1.0 µS/cm
Turbidity	± 5 NTU

Contents

List of Tables

1.0 PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) documents the project organization; presents the analytical procedures being used to produce data for the samples collected under the Field Sampling Plan (FSP); and, identifies the analytical and data review procedures to ensure the accuracy, precision, and representativeness of the samples so that project objectives presented in the FSP are met. This QAPP is one component of the Work Plan and FSP being developed to produce chemical data of know quality at the Veta Grande Mine Site, Nevada.

This QAPP has been reviewed by the CDM project QA coordinator, who will also maintain QA oversight for the duration of the project. All work performed on this project will be in accordance with the CDM QA Program described in CDM Federal's *Quality Assurance Manual* (CDM, 2001). All deliverables produced during the fieldwork and investigation will be subject to technical review by CDM technical specialists. Deliverables presenting measurement data will also be reviewed by an approved CDM QA reviewer. All documents developed during this project will be under the control of the CDM project manager who will maintain the project files. Audits or field surveillances will be performed in accordance with CDM Federal requirements.

1.1 PROJECT ORGANIZATION

Key positions and associated responsibilities for all individuals responsible for project management, data collection, data reporting, and review are provided below. Included are the functions of each individual and their lines of authority.

Bureau of Land Management Project Manager - Neal Brecheisen

- Review and approval of the project work plan and deliverables
- Review of field reports
- Provide project direction and oversight

United States Army Corps of Engineers Project Manager – B.J. Bailey

- Communicate with BLM Project manager project objectives and content
- Issue and oversee contractual issues
- Assure delivery of data and project deliverables to BLM
- Review project technical and data reports
- Provide project oversight

CDM Project Manager – Kevin Ryan

- Provide technical direction for all field activities
- Review and approve CDM deliverables

- Ensure compliance with project schedule
- Implement corrective or other actions necessary to complete the project scope

CDM Project Quality Assurance Manager – George Delullo

- Review QAPP and FSP for compliance with CDM's QA program
- Provide technical direction to the Project Manager and Field Team leader on quality assurance issues
- Conduct audits/surveillances of project reports for verification for adherence to the quality control procedures identified in this QAPP and the FSP

CDM Field Team Leader – Kerri Dierberger

- Assure that all sampling is conducted in accordance with the FSP and supporting SOPs
- Verify that all QC procedures are followed and QA samples are collected and managed in accordance with the QAPP
- Report any sampling problems to the Project Manager
- Assure completion of the field log book, field record sheets, and chain-of-custody forms

Analytical Laboratory – Sierra Analytical

- Provide pre-cleaned sample containers of the size and type listed in the FSP
- Conduct chemical analyses in accordance with the analytical procedures identified in this QAPP
- Calibrate and maintain equipment in accordance with manufacturers recommendations and the laboratory's QA plan
- Conduct internal QA/QC checks/procedures and provide CDM with verification records upon request
- Notify CDM's QA manager of any laboratory problems that jeopardize the quality of sample data or fail to address analytical method QC limits
- Deliver analytical reports in accordance with the subcontract agreement including results, QA/QC documentation, problems and corrections, and custody records.

1.2 PROJECT DESCRIPTION

1.2.1 Site Background

Background information regarding the Veta Grande Mine site and environmental issues that need to be addressed are provided in Section 1.0 of the Work Plan.

1.2.2 Data Acquisition Activities Governed by this QAPP

Three distinct sampling activities will occur as described in Section 2.1, 2.2, and 2.3 of the Work Plan. These activities include

- Sampling of cyanide waste for use in characterizing the waste for treatment and/or disposal considerations
- Sampling of groundwater from individual wells serving nearby residences and site monitoring wells
- Sampling of tailings for use in waste classification and closure method determination

Sampling procedures are described in the FSP. Section 3.0 of this QAPP provides the analytical procedures. Table B-1 provides a summary of the analytical schedule for sampling activities at the Veta Grande Mine site.

1.2.3 Special Training Requirements/Certifications

The Veta Grande mine site will be treated as hazardous waste site for purposes of identifying safety practices during field sampling and data collection. Appendix D presents the Health and Safety Plan. All personnel who enter an abandoned mine site must recognize and understand the potential hazards to health and safety associated with the site. All employees involved in sampling and site inspection activities will have training that meets the OSHA hazardous waste site worker 40-hour training requirement. Personnel responsible for the use of field instruments, sampling equipment, operating mechanical equipment, and powered equipment will receive necessary training for the safe and proper use of the equipment. Field activities will also be directed by a qualified geologist or engineer.

2.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES

2.1 ANALYTICAL PROCEDURES

Table A-1 of the FSP presents a summary of the analytical method, sample matrix, sample container, and sample preservative requirements for the analyses being performed under this program. Table B-2 presents the analytes with their respective detection limits for each matrix (water and soil). Table B-1 provides a summary of the samples to be collected by sampling locations with reference to the respective FSP Section.

Table B-1
Summary of Analytical Schedule
Veta Grande Mine, Nevada

Sample Location(s)	Matrix	Parameters	Estimated Number of Samples	Field Duplicates	MS/MSD	Reference
Cyanide Waste	Solid	Total, WAD, Free Cyanide, Metals, Meteoric Water Mobility Profile for Total, WAD, Free Cyanide, Metals	1	0	0	FSP Sect. 3.2
Domestic Well	Water	Total, WAD, Free Cyanide, Nevada Profile II Field Parameters	5/Quarter 11 Annually	1	1	FSP Sect. 3.3.1
Monitoring Well	Water	Total WAD, Free Cyanide, Nevada Profile II Field Parameters	6/Quarter	1	1	FSP Sect. 3.3.2
Tailing Impoundment 4	Solid	Total, WAD, Free Cyanide, Metals	11	1	1	FSP Sect. 4

2.2 MEASUREMENT/DATA ACQUISITION

2.2.1 Sample Handling and Custody Requirements

Procedures for sample handling and chain-of-custody control are provided in SOP 1-2 (Appendix C). The procedures within this SOP will be strictly adhered to during sample collection, transportation, and laboratory handling to ensure that the identity of the sample is maintained and that the sample is received intact and preserved in accordance with the procedure. Sample labeling and chain-of-custody development will also be in accordance with the SOP.

2.2.2 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Instrument calibration will be performed to ensure that all instrument functions are operating properly and the readings / measurements made by the instrument accurately reflect the conditions of the material being testing. Calibration of all instruments will be based on the manufacturers requirements. Calibration materials will be of known quality, concentration, and traceable to their sources. Field instruments will be calibrated at least daily or at a more frequent interval specified by the manufacturer.

The analytical laboratory will maintain and calibrate its equipment and instruments in accordance with its internal quality assurance program requirements. Criteria used for calibration will be derived from the manufacturers specifications and the requirements of the analytical procedure being followed. All calibration materials used by the laboratory will be traceable to a known source.

Table B-2
Sample Analytes and Detection Limits
Veta Grande Mine Site

Analyte	Analytical Method Water	Detection Limit Water (µg/L)	Analytical Method Soil	Detection Limit Soil (mg/kg)
Total Cyanide	USEPA 335.2	25	USEPA 9014	0.05
Free Cyanide	USEPA 335.2	25	USEPA 9014	0.05
WAD Cyanide	USEPA 1677	5	USEPA 1677	0.05
Antimony	USEPA 200.8	10	USEPA 6010	1
Arsenic	USEPA 200.8	5	USEPA 6010	1
Barium	USEPA 200.8	10	USEPA 6010	1
Beryllium	USEPA 200.8	4	USEPA 6010	1
Cadmium	USEPA 200.8	5	USEPA 6010	1
Chromium	USEPA 200.8	5	USEPA 6010	1
Cobalt	USEPA 200.8	10	USEPA 6010	1
Copper	USEPA 200.8	10	USEPA 6010	1
Lead	USEPA 200.8	5	USEPA 6010	1
Mercury	USEPA 245.1	0.2	USEPA 7471	0.2
Molybdenum	USEPA 200.8	20	USEPA 6010	1
Nickel	USEPA 200.8	10	USEPA 6010	1
Selenium	USEPA 200.8	5	USEPA 6010	1
Silver	USEPA 200.8	10	USEPA 6010	1
Thallium	USEPA 200.8	5	USEPA 6010	1
Vanadium	USEPA 200.7	10	USEPA 6010	1
Zinc	USEPA 200.7	20	USEPA 6010	10
Alkalinity	USEPA 310.1	1 mg/L $CaCO_3$		
pH	USEPA 9040B	0.1	USEPA 9045C	0.1
Chloride	USEPA 300.0	0.005	N/A	N/A
Fluoride	USEPA 300.0	0.001	N/A	N/A
Nitrate/Nitrite	USEPA 300.0	0.0005	N/A	N/A
Phosphorus	USEPA 365.1	0.0002	N/A	N/A
Sulfate	USEPA 300.0	0.00002	N/A	N/A
Total Dissolved Solids	USEPA 160.1	0.1	N/A	N/A
Meteoric Water Extraction			NDPE	See Water Methods

2.2.3 Inspection Requirements for Supplies and Consumables

All purchased supplies and consumables that support field monitoring and sampling activities or that have a direct relationship to sample quality (e.g., calibration standards, sample containers, decontamination fluids) will be inspected on receipt and noted in the field log book as origin of material and identification number(s) before the materials are used. At a minimum the inspection will include part, serial, or lot number; whether the material meets the requirements of the FSP and QAPP; whether the material is intact and has not been compromised (as to introduce foreign matter); and whether necessary documentation has been provided by the vendor.

Any non-conforming items will marked as not usable, set aside, and eventually returned to the vendor for replacement or other action as necessary.

2.2.4 Field Parameter Measurements

Field parameters will be measured during well development and sampling. The field parameters to be measured include:

- Conductivity
- Dissolved Oxygen
- pH
- Temperature
- Turbidity

CDM will operate the instruments in accordance with manufacturer's procedures provided with the instruments: Decision criteria for instrument readings are provided in the Table A-2 of the FSP. All readings will be recorded in the field log book. Instruments will be maintained and calibrated in accordance with the manufacturer's specifications.

3.0 DATA QUALITY CRITERIA

3.1 DATA REVIEW AND VERIFICATION REQUIREMENTS

The analytical laboratory performing the chemical tests listed in Table B-3 will responsible for reviewing all analytical data generated under the guidance of this QAPP to ensure that it meets all requirements. Each analyst will be responsible for reviewing the quality of their work based on the established protocols of the specific laboratory's SOPs, analytical method protocols, and project-specific requirements stated in the laboratory's subcontract. The laboratory will provide results in electronic and paper formats. At a minimum, the laboratory's data reviewer will check the sampling documentation (chain-of-custody), holding time, instrument calibration and tuning, lab blank sample analyses, method QC sample results, and the presence of any elevated detection limits.

Table B-3
Data Quality Objectives

Task	DQO Step	Investigation Statement	Work Plan Reference
Cyanide Destruction Demonstration Project	State the Problem	The cyanide waste is likely the source of groundwater contamination. Data are required to determine proper treatment/disposal options.	Section 2.2
	Identify the Decision	One representative sample for cyanide, total metals meteoric leachability, pH, and alkalinity will be collected to complete waste characterization.	
	Identify Inputs to the Decision	The new data will be combined with existing data to define chemical characteristics and environmental threats of the waste. The data will be used to identify treatment options.	
	Define the Study Boundaries	The study boundaries reflect the two contained waste masses.	
	Develop a Decision Rule	If it is determined that leachable quantities of cyanide are generated, the waste will require treatment before disposal.	
	Specify the Limits on Decision Error	Limits on analytical error are the internal laboratory DQOs including control limits for MS/MSD and LCS percent recovery, surrogate percent recovery, and detection limits.	
	Optimize the Design	By sampling the locations only once, sufficient data are expected to be generated to meet the DQOs.	
Domestic Well Sampling	State the Problem	Domestic wells have shown cyanide below its MCL for over 10 years. Concentration trends are upward.	Section 2.3.5
	Identify the Decision	Domestic wells will be sampled at the pump. Data will be compared with historical trends. The need for wellhead treatment will be assessed.	
	Identify Inputs to the Decision	Analytical data will be incorporated into trends data for action determination relative to the cyanide MCL.	
	Define the Study Boundaries	The study boundaries are domestic wells down gradient from the mine site.	
	Develop a Decision Rule	Cyanide groundwater concentration trends upwards to the MCL may necessitate wellhead treatment; downward trend may allow cessation of providing bottle water supplies.	
	Specify the Limits on Decision Error	Limits on analytical error are the internal laboratory DQOs.	
	Optimize the Design	By continuing data trend analysis decisions can be made regarding the need for wellhead treatment.	

Task	DQO Step	Investigation Statement	Work Plan Reference
Monitoring Well Sampling	State the Problem	Groundwater containing cyanide has affected domestic wells. The hydrogeology of the bedrock system in unknown.	Section 2.3.5
	Identify the Decision	Data are required on bed conditions to understand contaminant migration parameters. Monitoring points are needed at the mine site and adjacent receptors.	
	Identify Inputs to the Decision	Stratigraphy logging, fault mapping, and groundwater parameters are needed to characterize the hydrogeology.	
	Define the Study Boundaries	The entire area affected by cyanide.	
	Develop a Decision Rule	Understanding the hydrogeology can lead to determining locations for replacement well water.	
	Specify the Limits on Decision Error	Limits on analytical error are the internal laboratory DQOs including control limits for MS/MSD and LCS percent recovery, surrogate percent recovery and detection limits.	
	Optimize the Design	Surface mapping of bedrock features coupled with a review of existing groundwater data will be used to site new wells.	
Tailings Impoundment Characterization	State the Problem	The depth of tailings is not known. The chemical characteristics of the tailings for closure purposes need to be understood.	Section 2.4
	Identify the Decision	The chemical characteristics of the tailings will dictate closure requirements. If not hazardous, the tailings can be closed via a simple soil cover.	
	Identify Inputs to the Decision	Data will be utilized to determine the suitability of the tailings to simple soil cover.	
	Define the Study Boundaries	The study boundaries will be limited to tailings Dam 4.	
	Develop a Decision Rule	If the tailings results indicate leachable levels of cyanide, a cover preventing infiltration will need to be designed.	
	Specify the Limits on Decision Error	Limits on analytical error are the internal laboratory DQOs including control limits for MS/MSD and LCS percent recovery, surrogate percent recovery and detection limits.	
	Optimize the Design	The appropriate numbers of samples will be collected depending on the depth of the waste. Therefore, sufficient data are expected to be generated to meet the DQOs.	

A CDM data reviewer will check the documentation provided by the analytical laboratory to ensure that the information is complete and supports the analytical results. The CDM data reviewer will also review duplicate analyses and any field blanks for compliance with the precision goals established for the project.

3.2 LABORATORY QUALITY CONTROL

The laboratory's overall method performance will be monitored by the inclusion of various QC checks that allow an evaluation of method control (batch QC), and the effect of the matrix on the data being generated (matrix-specific QC). Batch QC is based on the analysis of a laboratory control sample (LCS) to general accuracy (precision and bias) data and method blank data to assess the potential for cross-contamination. Matrix-specific QC will be based on the use of an actual environmental sample for precision and bias determination from the analysis of matrix spike (MS), matrix-spike duplicate (MSD), and surrogate procedures. Laboratory QC will also be based on the labs internal QA / QC plan and SOPs.

3.2.1 Method Blank Samples

Method Blanks are analyzed by the laboratory to assess background interference or contamination that exists in the analytical system that might lead to reporting of elevated concentration levels or false positive data. The method blank is defined as an interference-free blank matrix similar to the sample matrix to which all reagents are added in the same volumes or proportions as used in sample preparation and carried through the complete sample preparation, cleanup, and determination procedures. For aqueous analyses, analyte-free reagent water would typically be used. The results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples. Sample results will not be corrected for blank contamination.

In general, one method blank sample shall be analyzed for each analytical batch (one every 12 hours for GC / MS analyses). Contamination in method blanks (as well as reagent blanks, instrument blanks, extraction blanks for elutriations, initial calibration blanks, and continuing calibration blanks) above the method detection limit (MDL) is not allowed. Data found to be associated with blanks containing target analytes at or above the MDL may be rejected with resampling and / or re-extraction and reanalysis at the expense of the laboratory. A CDM data reviewer will evaluate the data based on the level detected in the associated samples.

3.2.2 Laboratory Control Samples

The LCS is analyzed to assess general method performance by the ability of the laboratory to successfully recover the target analytes from a control matrix. The LCS is similar in composition to the method blank. Analtyte free water is used for aqueous analyses. A purified solid matrix is used for soil samples. Due to the difficulty of obtaining a solid matrix free from metals, analyte-free reagent water is taken through the appropriate digestion procedures for metals analysis. The LCS is spiked with all single-component target analytes before it is carried through the preparation, cleanup, and determinative procedures. The laboratory will perform corrective action based on failure of any analyte in the spiking list. When samples are not subject to a separate preparatory procedure, the continuing calibration verification (CCV) may be used as the LCS, provided that the CCV acceptance limits are used for evaluation. The spiking levels for the LCS would normally be set at the project-specific action limits assuming that the low standard used for the initial calibration was below this limit. If the low standard used was at this limit or if the site action levels were unknown, then the spiking levels would be set between the low and mid-level standards. The results of the LCS are evaluated in conjunction with other QC information, to determine the acceptability of the data generated for the batch of samples. The laboratory shall also maintain control charts, or tables for these samples to monitor the precision. The precision may be evaluated by comparing the results for the LCS batch-to-batch or duplicate LCSs.

3.3 DATA QUALITY OBJECTIVES

Data quality criteria address precision, accuracy, representativeness, completeness, and comparability (i.e., PARCC indices) of the data. A brief description of each parameter is provided below. The data quality objectives for the sampling and analytical program governed by this QAPP are provided in Table B-3.

3.3.1 Precision

Precision refers to the level of agreement among repeated measurements of the same characteristics, usually under a given set of conditions, and is expressed quantitatively as a measure of variability of a group of measurements compared to their average value. Precision can be expressed as the standard deviation and as relative percent difference (RPD) between measurements of the same parameter. Relative standard deviation (RSD) may also be calculated. For this project, laboratory duplicate analyses will be used to assess analytical precision.

3.3.2 Accuracy

Accuracy refers to the degree to which a measurement agrees with an accepted reference or true value. Accuracy is a measure of bias in a measurement system. Sources of error that introduce bias are the sampling process, field contamination, preservation, sample handling, matrix, sample preparation, analysis techniques, and data reduction. Analytical accuracy will be assessed using laboratory standard reference materials.

3.3.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Subjective factors to be taken into account are the degree of homogeneity of a site, the degree of homogeneity of a sample taken from one point at a site, and the available information on which a sampling plan is based.

For this project, field duplicates will be collected and analyzed to assess representativeness. Two samples collected from the same location and at the same time are considered to be equally representative of the condition, at a given point in space and time.

The laboratory's objective for representativeness is to ensure that sample data accurately represent the distinguishing characteristic of a sample source. Laboratory analytical procedures, such as the homogenization of a sample prior to aliquot removal, will ensure that each aliquot represents the whole sample from which it was extracted. Thus, laboratory procedures will not interfere with the concentration or composition of the analytes in the sample.

3.3.4 Completeness

Completeness is a quantitative measurement of the amount of valid, usable data obtained from a measurement system compared to the amount expected under normal conditions. A certain amount and type of data must be collected in order for conclusions based on that data to be deemed valid. Due to the limited number of samples proposed for collection under this work plan, a completeness goal of 100% is required in order to meet the overall project objectives.

3.3.5 Comparability

Comparability represents the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved sample collection techniques and analytical methods, consistency in the basis of analysis (weight, volume etc.), consistency in reporting units, and analysis of standard reference materials. The data generated during one groundwater sampling round will be comparable to data generated during any other groundwater sampling round at by using the same standard unit of µg/L (micrograms per liter).

A State of Nevada-certified analytical laboratory will use standard operating procedures as described in their QA plan. USEPA-approved sampling and analytical methods will be used.

4.0 QUALITY CONTROL RESPONSIBILITIES

All of the selected staff for this project have the qualifications and experience required for conduction their specific assignments. If staff changes are necessary during the execution of this work, resumes shall be submitted for new personnel, and a description of their responsibilities, in a technical memorandum to the USACE Project Manager. All CDM project personnel are responsible for identifying, reporting, and documenting any activities that could adversely affect the quality requirements set forth by the contract.

The laboratory has a designated project manager for this project and who will provide direct interface with CDM personnel. The Laboratory Project Manager will be responsible for ensuring that all analytical data generated under this contract are reviewed prior to their release to CDM and the USACE Project Manager. He has sufficient authority to assure that samples submitted from the project site are received and processed in accordance with this QAPP.

5.0 RECONCILIATION WITH DATA QUALITY OBJECTIVES

An assessment of data quality will be performed to determine whether data generated are consistent with the investigation objectives. If data are found to deviate significantly (several orders of magnitude) from previous analyses or surrounding conditions upon which the sampling program was based, the data may be qualified based on the validator's assessment of the usability of the data for the intended end uses.

6.0 CORRECTIVE ACTION

Corrective action is required when potential or existing conditions are identified that may have an adverse impact on data quality. Corrective action applies to both the field and laboratory procedures. In general, any member of the project team who identifies a condition adversely affecting quality can initiate corrective action. Written evidence (e.g. field or laboratory logbook) will document and identify the condition and explain the way it may affect data quality.

A well-defined and effective policy for correcting quality problems is critical to the success of a quality assurance program. While this QA program is designed to minimize problems, it must also identify and correct any problems that do exist. The corrective action system for this project will include:

- Identify the problem
- Identify cause of the problem
- Identify corrective actions to correct the problem
- Implement corrective actions
- Verify effectiveness of corrective actions in correcting the problem
- Document corrective action including:
  - Problem identified and cause
  - Corrective actions implemented
  - Effectiveness of corrective actions
  - Samples impacted by problem

Documentation of corrective actions will be included in the project file.

APPENDIX C

CDM STANDARD OPERATING PROCEDURES FOR FIELD DATA COLLECTION

SOP Identifier	SOP Title
SOP 1-2	Sample Custody
SOP 1-3	Surface Soil Sampling
SOP 1-4	Subsurface Soil Sampling
SOP 1-5	Groundwater Sampling Using Bailers
SOP 1-6	Water Level Measurement
SOP 1-9	Tap Water Sampling
SOP 2-1	Packaging and Shipping of Environmental Samples
SOP 2-2	Guide to Handling Investigation-Derived Waste
SOP 3-4	Geophysical Logging, Calibration, and Quality Control
SOP 3-5	Lithologic Logging
SOP 4-1	Field Logbook Content and Control
SOP 4-2	Photographic Documentation of Field Activities
SOP 4-3	Well Development and Purging
SOP 4-4	Design and Installation of Monitoring Wells in Aquifers
SOP 4-5	Field Equipment Decontamination at Non-radioactive Sites

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1.0 STANDARD ABANDONED MINE SITE HEALTH AND SAFETY PROCEDURES

Abandoned mine sites pose three types of potentially serious risks to the casual visitor: physical, chemical, and explosive (combined physical and chemical). The following procedures and precautions will be followed by the CDM sampling team inspecting and collecting data at the Veta Grande mine site.

Abandoned mine sites involve a number of physical hazards ranging from steep, unstable slopes that could result in a serious fall; tripping hazards due to uneven terrain, debris, and abandoned equipment; unsafe and collapsed structures; unsafe (potential for collapse) adits; unsafe cribbing walls and tailing dam impoundments (risk of failure) and unprotected, vertical shafts of unknown depth. The sampling team must wear steel-toed, steel-shank work boots as a measure of protection against ground hazards (e.g., sharp metal, protruding nails). The sampling team must also wear full-length work pants (denim or similar material) to provide protection from protruding objects, rusted metal, and chemical materials (heavy metals, cyanide, low pH) that may be present at the mine site.

Under no circumstance should any member of the sampling team enter buildings or adits, or climb on any structures including crib walls. Steep slopes should be avoided. The location of any head frames (intact or collapsed) should be noted. These locations should be avoided. There may be a hidden or unstable opening to a vertical shaft near the head frame.

Drill rigs are extremely hazardous when operating. The CDM geologist supervising drilling and well installation must always wear a hard hat and steel toed shoes whenever working within 100 ft of the rig. The CDM geologist must wear eye protection when working within 25 ft of the rig when it is drilling or during installation of the monitoring well. Hearing protection is highly recommended whenever the rig is operational.

Chemical hazards posed by abandoned mine sites include high concentrations of heavy metals with arsenic, cadmium, and lead being of greatest concern. Soil, waste rock, and/or water may contain extremely low (<2 pH) or high (>12 pH) acidic or basic conditions that can cause skin burns, eye irritation, and/or eye damage. Various chemicals used in ore processing, including cyanide and mercury, can be present in high concentrations; therefore, caution must be used when handling and processing samples of waste rock, stained soil, or mine site runoff. The sampling team will use disposable gloves when handling samples. Hands must be thoroughly washed following sampling. Samplers should not drink or eat food during sample collection and processing.

Liquid containers (20 to 55 gallon drums, 5 to 10 gallon cans) are commonly found at mine sites. These containers typically were used to store fuels (diesel, gasoline, kerosene) and lubricating oils. The presence and condition of liquid containers should be noted in relation to the primary sample locations, but no further investigation will be performed under this study.

2.0 VETA GRANDE MINE SITE HEALTH AND SAFETY ISSUES

The Veta Grande mine site has waste materials containing cyanide. Use of cyanide was not permitted at the mine site and may be present in locations not previously identified. Cyanide is extremely toxic via inhalation and ingestion routes of exposure. Before sampling of any material suspected or known to contain cyanide, the area of and around the material to be sampled must be surveyed using cyanide detecting equipment. The sampler using the cyanide detecting equipment must be trained in its usage and verify its proper function through calibration tests prior to its use in the field. Field samplers must use protective gloves when sampling and handling material suspected of containing cyanide. Hands must be washed thoroughly following sampling. Field clothing should be separated from other clothing when laundered.

Explosives and dangerous chemicals may still be present at the mine site. The site was once an illicit drug manufacturing laboratory so dangerous chemicals are of concern. Crates, boxes, bottles, and bags should not be opened, but their presence noted in the field log book. Items such as blasting caps, primer cord, or dynamite sticks should be noted but never touched. If observed, the BLM and USACE project managers must be contacted immediately. The presence of these materials can be ascertained by observing the contents of sheds and structures from the outside. The scope of this study does not involve explosives or stored chemicals and no further investigation should be performed until otherwise directed by the USACE project manager.

3.0 SITE – SPECIFIC WORK ACTIVITIES GOVERNED BY THIS SAFETY PLAN

The Veta Grande Mine Site Work Plan addresses several sampling and site characterization activities potentially involving contact with soil and groundwater containing cyanide. The sampling work will occur at various locations on and off the mine site. The work will also involve the installation of monitoring wells using a drill rig and sampling of subsurface soils.

Site activities will include the following:

- Domestic well samplings
- Well installation and sampling
- Borehole drilling and sampling
- Samples of cyanide waste material

The Work Plan, Sections 2.2, 2.3, and 2.4 provide additional details regarding these activities.

4.0 CHEMICAL HAZARD

Data collected for site waste and groundwater shows the presence of cyanide. Concentrations are not immediately health threatening, but waste and groundwater should be handled using protective clothing and proper containment.

5.0 PERSONAL PROTECTIVE EQUIPMENT

The cyanide in waste and groundwater does not pose an inhalation risk. This will be confirmed by through the use of a cyanide gas detector meter. Therefore, level of protection will be level D consisting of standard field clothes, steel-toed boots, and work gloves. Hard hats, hearing protection, and eye protection will be required while all drilling equipment is operating.

6.0 VETA GRANDE MINE SITE SAFETY CONCERNS CHECKLISTS

Cyanide	-	A cyanide gas detector will be used for all activities involving contact with waste. This includes the sampling of the waste stored in the “burrito” and the drilling into the tailings impoundment. Any detection of cyanide by the instrument will be cause for cessation of work.
	-	Gloves will be worn during sampling to prevent direct skin contact with the waste.
	-	Work clothes worn during sampling will be laundered separately from other personal items
	-	Hands will be washed following sampling and prior to eating.
Metals	-	The mine waste contains elevated concentrations of metals. Gloves will be worn to prevent direct contact with the waste.
	-	Work clothes worn during sampling will be laundered separately from other personal items.
	-	Hands will be washed following sampling and prior to eating.
Drill Rig – General	-	The drill rig will be hoisting and lowering downhole equipment. Site personnel should stay at least 20 feet away from the rig when operating.
	-	All site personnel must wear hard hats, steel toed boots, and safety glasses when working near the rig.
Drill Rig – Noise	-	Drill rigs can produce noise levels exceeding OSHA limits requiring ear protection. All personnel working near the rig must wear ear protection.
Drill Rig – Heat	-	Drill rigs can produce excessive heat during operations. Downhole equipment can exit the hole at temperatures exceeding 150°F due to the friction of drill bit and sampling equipment. Sampling devices and core taken from the borehole must be handled with gloves until the metal or core cools to ambient levels.
Groundwater	-	Groundwater at the site contains cyanide at levels below its MCL. Although not considered hazardous, groundwater should be handled carefully to minimize spillage from sampler while pouring into the sample containers. Protective gloves are recommended.
Domestic Wells	-	Many of the property owners have pet dogs that can also serve as guard dogs. Domestic well locations with dogs should be approached cautiously and only with the owners control of the dog.

7.0 VETA GRANDE MINE SITE CONTACTS:

Kevin Ryan	CDM Project Manager	775-853-0333
B.J. Bailey	USACE Project Manager	916-557-6642
Neal Brecheisen	BLM Project Manager	775-885-6121
Robert Saiz	CDM E&C H&S Officer	303-298-1311
Chuck Meyers	CDM Federal H&S Officer	703-968-0900

Carson Valley Medical Center Emergency Medical Facility	775-782-1500
REMSA Ambulance Service	911 or 775-858-6000
County / State Police	911

8.0 ROUTE TO NEAREST MEDICAL FACILITY:

From the Veta Grande mine site, proceed north on U.S. Highway 395 for approximately 10 miles to the Carson Valley Medical Center at 1107 U.S. Hwy 395 in Gardnerville. The medical center is located north of Pine Nut Road and south of Virginia Ranch Road.

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1.0 SITE SECURITY PLAN

The Veta Grande Mine site is on land controlled by the BLM. Other than those activities described below, CDM will not be responsible for site security.

Site Access

CDM will contact BLM before entering the site. CDM will obtain from BLM the key to access the site gate. CDM will close and lock the gate after all entries and after leaving the site.

Work Site Control

CDM will maintain control of the immediate area of all work sites. This primarily will involve controlling public access to drilling sites. The CDM field team leader will greet all individuals approaching the work site, explain the objectives of the activity, and keep the individual(s) away from any area of physical or chemical hazard.

Limitations on Site Security

CDM has not been tasked to conduct the following site security activities, therefore, these activities will not be CDM's responsibility: maintenance or repair of fencing or gates, maintenance of signage, control of trespassers or unauthorized individuals (except in the immediate vicinity of CDM work activities), control of materials or structures on the site, nor providing a guard or a guard service.